ARDUINO BASED FINGERPRINT DOOR LOCK SYSTEM

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ABSTRACT

From earlier times as well as till now, security was an important issue of concern in our households and also in office, shops, etc. Everyone has a fear of unauthorized person entering to their home or office without their knowledge. The normal door can be fitted with locks which are capable of breaking with the use of an alternate key. Alternatives to this system can be found like the password or pattern system in the locks which again has the possibility of getting exposed and opening the lock. So, a solution to such problems can be by combining door lock with biometrics. Biometric verification is any means by which a person can be uniquely identified by evaluating one or more distinguishing biological traits. Unique identifiers include fingerprints, hand geometry, earlobe geometry, retina and iris patterns, voice waves, DNA, and signatures. Here we will use fingerprint for biometric verification as it is one such thing which is unique to every individual and the use of fingerprint as the key to door locks can overcome the security problem of unauthorized people trespassing to our homes, shops, offices, etc to a great extent as duplicity in such key is not possible. Also, this system will not lead to problems like losing keys because we do not require carrying keys. This system can be used instead of traditional locks. So, using arduino we will try to implement the system with features which will increase the security level.

Keywords: Door Lock.

I.   INTRODUCTION

Security in the office/corporate world is a big concern for everyone these days, whether they are away from Home or at home. Protection services are one of the most important issues in today's busy dynamic society, Where humans are unable to provide security for their private belongings manually. Instead, he comes up with A different approach that provides faster, more dependable and atomized protection. This is an age in which Everyone is linked through the internet, and everyone can access information from anywhere on the planet.

As a result, the possibility of having one's information stolen is a significant concern. Because of these Dangers, it's critical to provide some kind of personal identity to enter one's info. Personal identity is becoming Increasingly relevant in today's world. We mainly see password and identity card strategies among Mainstream personal identification approaches. However, passwords are now easily hacked, and identity cards Can be misplaced, rendering these approaches ineffective. Certain cases are very aggravating, such as when a person locks himself out of his home or office and leaves His key inside, or when a robber simply breaks the lock and takes everything. People who use a manual door Lock or keys are still troubled by circumstances like this. In other cases, some people are responsible for Locking up houses or offices and holding the keys secure. However, there are occasions where the person in Possession of the keys is unable or has gone through an emergency routine, which may trigger an unwelcome Interruption for those who need the key immediately. These are only a few of the problems that people can encounter while using keys or smart cards. That's where our fingerprint-based lock scheme comes in handy. Our architecture is applied to offer greater security so Users do not need to recall passwords or carry around keys or cards that are often misplaced. If a person's Fingerprint is approved in the device, he will not experience any delays when entering a room Fingerprint recognition Is one of the most reliable technologies and no two people's fingerprints are identical. Unauthorized access can thus be limited by creating a lock that stores the fingerprints of one or more Registered users and unlocks the system only when a match is made.

Problem Definition / Statement

The previous project developed in academic year 2020-21 is a Digital Code Lock System operates on keypad. Any person can open the door who knows the pass keys. Hence, Digital code lock system cannot authenticate the person hence any one can easily enters which results in theft occurrence or mishappening. To overcome the problem of Authentication in previous system, we introduced the fingerprint-based Door Lock System.

II. METHODOLOGY

Block Diagram

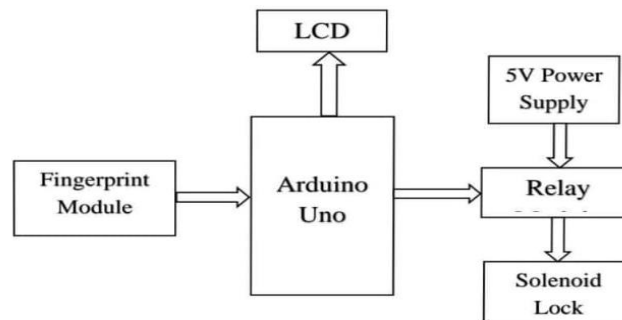The block diagram of our project is as

Fig. Block Diagram of Arduino based Fingerprint Door Lock System

The block diagram description is as follows

Hardware Components :

In our project we are using following components

1. Arduino Uno
2. Fingerprint Sensor
3. LCD Display
4. Relay Module
5. Solenoid Lock

Software

Arduino IDE (Integrated Development Environment) is used to program the Arduino Uno board.

Arduino Uno

Arduino Pin Configuration

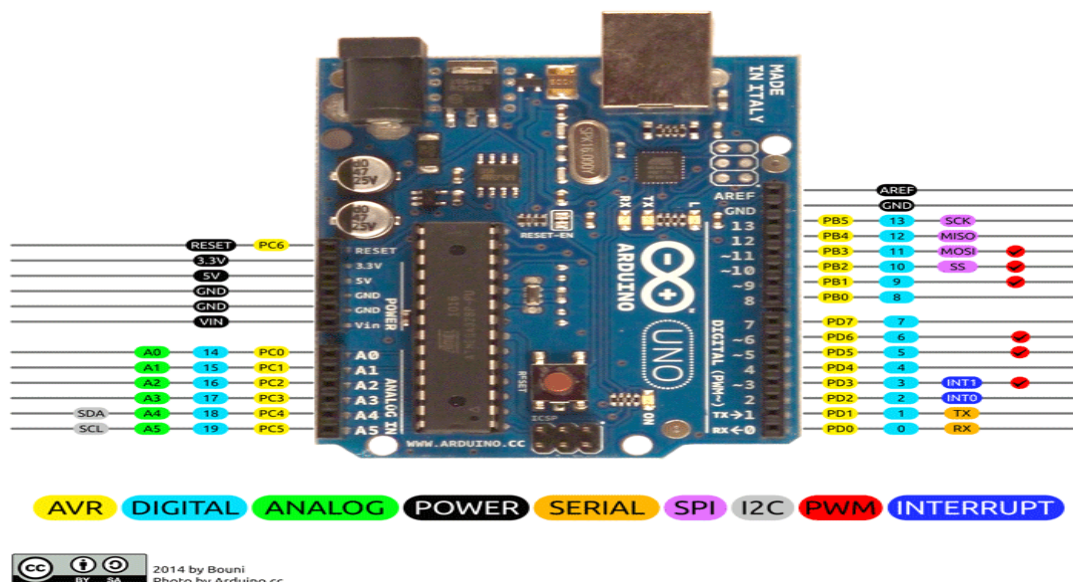Pin configuration of Arduino is as follows

Fig. Arduino Uno Pin Configuration

Arduino Uno is a popular microcontroller development board based on 8-bit ATmega328P microcontroller. Along with ATmega328P MCU IC, it consists other components such as crystal oscillator, serial communication, voltage regulator, etc. to support the microcontroller.

Arduino Uno is a microcontroller board based on 8-bit ATmega328P microcontroller. Along with ATmega328P, it consists other components such as crystal oscillator, serial communication, voltage regulator, etc. to support the microcontroller. Arduino Uno has 14 digital input/output pins (out of which 6 can be used as PWM outputs), 6 analog input pins, a USB connection, A Power barrel jack, an ICSP header and a reset button.

How to use Arduino Board.

The 14 digital input/output pins can be used as input or output pins by using pinMode(), digitalRead() and digitalWrite() functions in arduino programming. Each pin operate at 5V and can provide or receive a maximum of 40mA current, and has an internal pull-up resistor of 20-50 KOhms which are disconnected by default. Out of these 14 pins, some pins have specific functions as listed below:

- **Serial Pins 0 (Rx) and 1 (Tx):** Rx and Tx pins are used to receive and transmit TTL serial data. They are connected with the corresponding ATmega328P USB to TTL serial chip.
- **External Interrupt Pins 2 and 3:** These pins can be configured to trigger an interrupt on a low value, a rising or falling edge, or a change in value.
- **PWM Pins 3, 5, 6, 9 and 11:** These pins provide an 8-bit PWM output by using analogWrite() function.
- **SPI Pins 10 (SS), 11 (MOSI), 12 (MISO) and 13 (SCK):** These pins are used for SPI communication.
- **In-built LED Pin 13:** This pin is connected with an built-in LED, when pin 13 is HIGH – LED is on and when pin 13 is LOW, its off.

Along with 14 Digital pins, there are 6 analog input pins, each of which provide 10 bits of resolution, i.e. 1024 different values. They measure from 0 to 5 volts but this limit can be increased by using AREF pin with analog Reference() function.

- Analog pin 4 (SDA) and pin 5 (SCA) also used for TWI communication using Wire library.

Arduino Uno has a couple of other pins as explained below:

- **AREF:** Used to provide reference voltage for analog inputs with analogReference() function.
- **Reset Pin:** Making this pin LOW, resets the microcontroller.

Communication

Arduino can be used to communicate with a computer, another Arduino board or other microcontrollers. The ATmega328P microcontroller provides UART TTL (5V) serial communication which can be done using digital pin 0 (Rx) and digital pin 1 (Tx). An ATmega16U2 on the board channels this serial communication over USB and appears as a virtual com port to software on the computer. The ATmega16U2 firmware uses the standard USB COM drivers, and no external driver is needed. However, on Windows, a .inf file is required. The Arduino software includes a serial monitor which allows simple textual data to be sent to and from the Arduino board. There are two RX and TX LEDs on the arduino board which will flash when data is being transmitted via the USB-to-serial chip and USB connection to the computer (not for serial communication on pins 0 and 1). A Software Serial library allows for serial communication on any of the Uno's digital pins. The ATmega328P also supports I2C (TWI) and SPI communication. The Arduino software includes a Wire library to simplify use of the I2C bus.

Arduino Uno to ATmega328 Pin Mapping

When ATmega328 chip is used in place of Arduino Uno, or vice versa, the image below shows the pin mapping between the two.
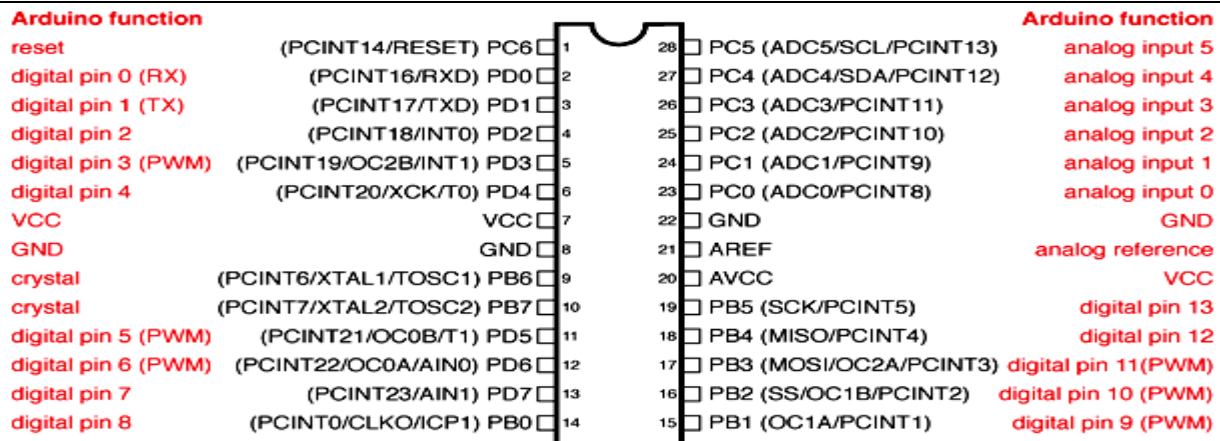
Fig. Arduino Uno to ATmega328 Pin Mapping

LCD Display :

In LCD 16×2, the term LCD stands for Liquid Crystal Display that uses a plane panel display technology, used in screens of computer monitors & TVs, smartphones, tablets, mobile devices, etc. Both the displays like LCD & CRTs look the same but their operation is different. Instead of electrons diffraction at a glass display, a liquid crystal display has a backlight that provides light to each pixel that is arranged in a rectangular network. Every pixel includes a blue, red, green sub-pixel that can be switched ON/OFF. Once all these pixels are deactivated, then it will appear black and when all the sub-pixels are activated then it will appear white. By changing the levels of each light, different color combinations are achievable.

Features of 16×2 LCD display:

• Operating voltage: 4.7v to 5.3v.
• Current consumption is 1mA without backlight.
• Alphanumeric LCD display Module, meaning can displays alphabets and numbers.
• Consist of two rows and each row can print 16 characters.
• Each character is built by a 5×5-pixel box.
• Can work on both 8 bit and 4-bit mode.
• Available in green and blue backlight.

Fig. LCD Display

Fingerprint Module :

The fingerprint module is a key to transform an ordinary access control. It captures, stores and matches the user's fingerprint, and can more implement functions through various protocols provided.

Features of Fingerprint Module :

➢ Fingerprint scanner is a popular security barrier which can be found in all sorts of high-end devices that are currently on the market.

➢ It is fast & easy to use.

➢ It can be used as an alternative or a complement to those hard-to-remember passwords.

➢ Power use is low, small in size.

Fig. Fingerprint Module

Solenoid Lock:

The solenoids are simple electrical components and it has many uses in daily life. The term itself is derived from the Greek name "solen", which illustrates a channel or a pipe. The second part of the name is taken from the Greek name "eidos", which refers to an outline. Basically, it is a component in the form of a pipe. The solenoid is used in a variety of applications, and there are numerous types of solenoid designs available. Each of them has their own properties that make it useful in many precise applications.

Features of Solenoid Lock:

➢ Operating voltage : 12VDC

Fig. Solenoid Lock

III. DETAILS OF DESIGNS, WORKING AND PROCESSES

Circuit Diagram

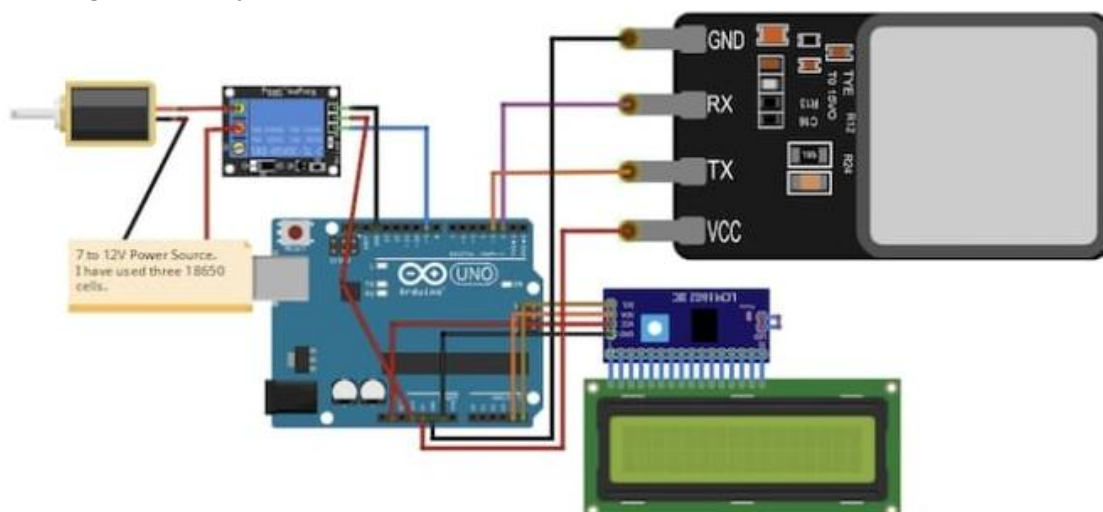The circuit diagram of our system is as

**Fig.** Arduino Based Fingerprint Door Lock system

Working :

First the Arduino and LCD will be energized using power supply. When the power will energize then fingerprint module will ON. LCD will show the message as "Insert your Finger". Whenever anyone inserts the finger on fingerprint module, the finger will be detected. The Arduino Uno check whether the entered finger is matched with stored finger data or not. If the finger is matched then the raspberry pi will send a signal to LCD and displays the message as **"Access Granted"**, after that the door will be opened. If the finger is wrong, then door will not be opened. It will display the message as **"Wrong Finger** or **Access Denied"**.
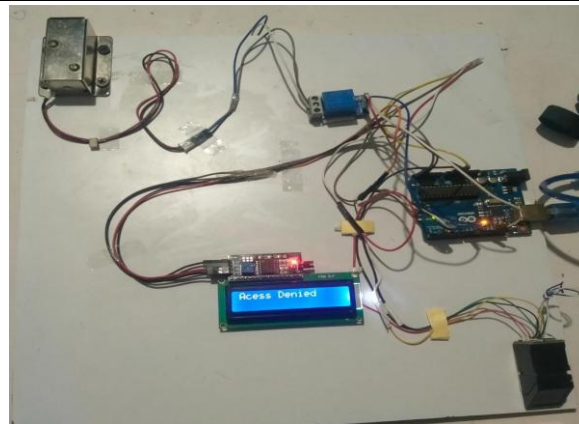
Flow Chart
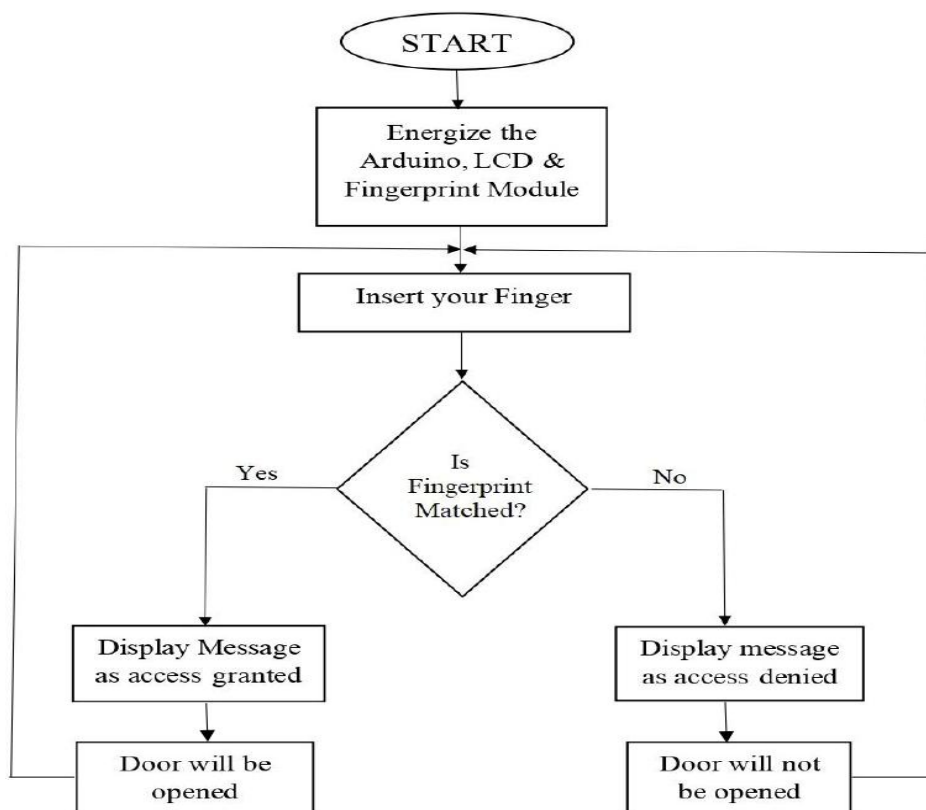
IV.   RESULTS AND APPLICATION

Results
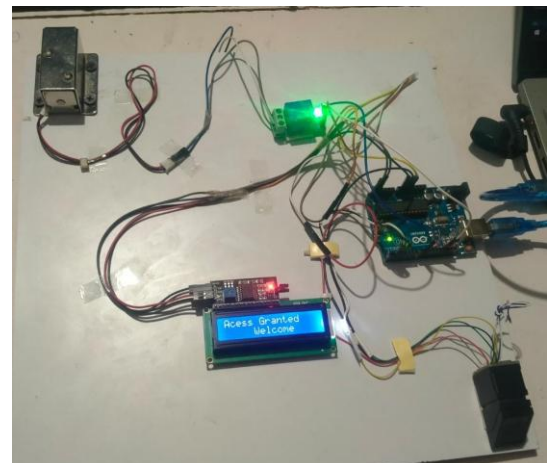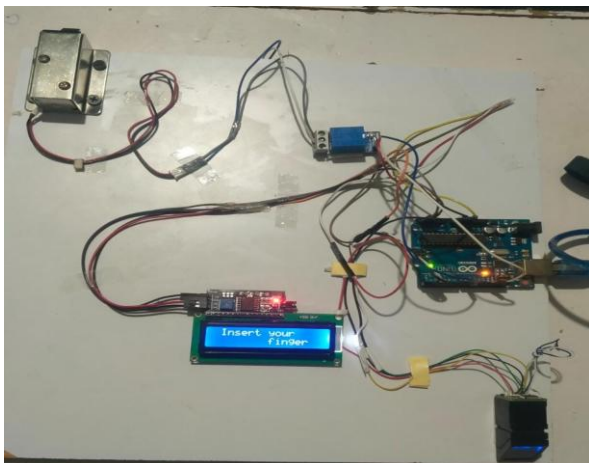
Applications

1. Fingerprint-based security system" project can be used by the employees, staff or workers in various industries like Automobile industries, manufacturing industries, Software development companies.

2. Home or domestic application: This project can be used to automate the door locking process at our home, so the user needs not to carry the door lock keys ...

3. Bank Lockers or security safes: Many of the banks use key based or password-based locks for their lockers or safes.

V.   CONCLUSION

The design and implementation of fingerprint-based door lock system is customizable and flexible. This door locking mechanism is comparatively cost-effective than the available lock systems in the traditional market. Our fingerprint-based lock system has high accuracy rate and is also quick to recognize fingerprints which enable seamless integration with the users and provides tighter security. In our country, private and government organizations are very much concerned about security. Many companies are interested in using this type of locking mechanism but the system which is available have very high installation cost. Due to this excessive cost, many small firms cannot afford such systems. Keeping the installation cost in mind we planned to develop a system that should be affordable to both large and small firms.

This design can be improved by more intensive development and additional features such as more locks can be added to the system. Thus, we do not need to spend so much for just one lock if this can be used to control several doorways. A system to save prints without the use of a computer could have been made, but it will require more parts than the ones we used. In order to maintain security properly, the whole mechanism should be placed inside the door panel or on the other side of the door. One of the main advantages of this system is its flexibility. Several other systems can be implemented with this system. The system is very secure. Fingerprints are unique and the sensor is able to identify all of the prints during testing. There are some drawbacks of this system such as this system is complicated and difficult to make any change in the hardware as it is a closed system. Also, it needs high power to operate so providing continuous power through batteries is a challenge sometimes.

VI.   REFERENCES

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